

# NAMRU-SA project developing tools to detect harmful bacteria in wounded warfighters

By David DeKunder | 502nd Air Base Wing Public Affairs | Nov. 7, 2018

## JOINT BASE SAN ANTONIO-FORT SAM HOUSTON, Texas —

Finding and developing diagnostic tools that can better identify harmful bacterial pathogens in wounded warfighters is the objective of two projects being conducted at Naval Medical Research Unit San Antonio at Joint Base San Antonio-Fort Sam Houston.

The research projects involve the use of surface-enhanced Raman spectroscopy, or SERS, and technological advances to effectively identify and detect bacterial pathogens in the wounds of injured service members in a timely manner, so the bacteria can be treated quickly before it spreads.

Dr. Luis Martinez, NAMRU-SA Craniofacial Health and Restorative Medicine research microbiologist and principal investigator for the projects, said microorganisms are capable of causing diseases in the body including viruses, bacteria, parasites and fungi. Diseases arising from bacterial infection contribute to approximately 35 percent of all combat casualties.

He said bacterial pathogens are able to enter the wounds of injured service members and, if not treated properly, can cause fatal complications including septic shock, in which internal organs and tissues in the body start to shut down because the bacteria overwhelm the immune system, and bacteremia, the presence of bacteria in the bloodstream.

Martinez said current diagnostic assays and tools that are used to detect and identify bacterial pathogens, including immuno, biochemical and molecular assays, require a lab setting, extensive training, and personnel.

These assays are also time-consuming, sometimes taking from 18 to 24 hours or up to two weeks to obtain results. In order to circumvent these lengthy and cost-prohibitive steps, substantial focus has been placed on advancements in the field of Raman spectroscopy, owing to its ability to rapidly identify and characterize microbes as well as their responses to various environmental factors.

SERS can be utilized as a diagnostic technique in which bacteria are adsorbed onto nanostructured gold or silver surfaces and irradiated. Laser interaction with the metallic nanostructures facilitates dramatically enhanced localized electric fields which give rise to increased detection thresholds. Interactions with the bacterial cell surface gives rise to scattering events capable of generating unique spectral fingerprints for each bacterial strain.

The use of these spectral fingerprints in combination with various mathematical techniques allow researchers to detect and classify the type of bacterial pathogen present in the body.

Martinez said that SERS as a diagnostic tool provides many advantages, in particular the ability to rapidly probe biological specimens adsorbed onto nano-metallic surfaces and detect the presence of pathogens. By using this technique identification of the bacteria can be accomplished within a few hours requiring minimal processing. Current diagnostic tools involve meticulous processing, often requiring cultures of bacteria to grow overnight or for several days prior to obtaining results.

In addition, SERS-based platforms are often portable and can be deployed to austere environments to provide point-of-care diagnostics to wounded service members. Once these systems are fully optimized, Martinez said SERS will have the capability to be adapted to handheld devices and table top microscopes.

He said work is being done to create a data library system of bacterial pathogen samples that will be installed in the handheld tablet device. The data system will identify the type of bacterial pathogens that are scanned onto the device.

## Photos



"By being able to diagnose or identify the bacteria a lot faster, treatment can be conducted within hours instead of waiting days or even weeks for results," Martinez said.

NAMRU-SA has been conducting research on diagnostic tools for bacterial pathogens for six years.

Martinez said the next phase of research will focus on developing diagnostic tools for identifying and detecting bacteria in waterborne pathogens. He said he hopes the findings from the next phase can be utilized for future humanitarian missions; for example, treating patients in a natural disaster such as hurricane who may contract bacteria pathogens from water, and help military units in austere environments identify whether a water source can be utilized for drinking water or not.

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